BULLETIN
PENNSYLVANIA DEPARTMENT OF AGRICULTURE.
HARRISBURG, PA.

Vol. 8 MAY, 1925 No. 8

General Bulletin No. 404
(No. 363 Revised)

# Bovine Infectious Abortion

By

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Bureau of Animal Industry

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Published monthly by direction of the Secretary. Entered as second class matter, March 22, 1918, at the Post Office at Harrisburg, Pa., under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103. Act of October 3, 1917, authorized on June 29, 1918.

Harrisburg, Pa.

1925.

# PENNSYLVANIA DEPARTMENT OF AGRICULTURE

## Organization and Services.

FRANK P. WILLITS, *Secretary* JOHN M. McKEE, *Deputy Secretary.*

This Department is essentially a service agency created by legislative enactment to deal with administrative, regulatory, investigational, and educational problems which can best be solved through public rather than individual action. The organization provides for coordination and cooperation with the Pennsylvania State College and the U. S. Department of Agriculture. The Department operates through the following bureaus:

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Prevents and eradicates transmissible diseases of animals and poultry, including tuberculosis of animals in cooperation with Federal Government.

Demonstrates to veterinarians control methods for transmissible animal diseases;

Supervises vaccination for and the prevention of hog cholera, anthrax, black leg and hemorrhagic septicemia;

Protects public from unwholesome meats through ante and post mortem examinations of animals at slaughtering establishments;

Inspects, licenses and furnishes information as to breeding, soundness and conformation of stallions and jacks standing for public service;

Enforces law requiring licensing of dogs and providing for protection of livestock and people from attacks of uncontrolled dogs;

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Inspects orchards, parks, farms, and plant imports for injurious insects and plant diseases;

Inspects and licenses Pennsylvania nurseries, and licenses all dealers in nursery stock;

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Places and enforces quarantines and carries on eradication campaigns against insect pests and plant diseases;

Inspects and certifies potatoes for seed purposes;

Makes investigations for the control of injurious insects and plant diseases including field tests of insecticides, fungicides and weed killers;

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Accomplishes its purpose of protecting Pennsylvania homes against harmful foodstuffs by sampling, analyzing, and bringing prosecution under the laws relating to foods and non-alcoholic drinks, including milk, cream, butter, ice-cream, eggs, sausage, fresh meats, soft drinks, fruit syrups, vinegar and kindred food products;

Regulates and issues licenses for the manufacture and sale of oleomargarine;

Licenses and regulates egg-opening plants and cold storage warehouses, maintaining regular inspection and enforcing twelve-month storage limit;

Inspects milk plants and creameries and regulates weighing, testing, buying and selling of milk and cream on a butterfat basis;

Protects honest manufacturers, importers, selling agents and ultimate users of feeding stuffs, fertilizers, lime products, linseed oil, paint, putty, turpentine, insecticides and fungicides, by means of annual registrations followed by inspections, analyses, prosecutions and the publication of the analyses of these products;

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MARKETS: P. R. TAYLOR, *Director.*

Investigates and assists in the marketing of farm products; at present chiefly grain and hay, fruits and vegetables, poultry and eggs, and tobacco;

Compiles and distributes daily market information as to supplies, shipments and prices:

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Assists cooperative associations and public markets;

Establishes standard grades of farm products and maintains inspection.

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Assembles and disseminates essential statistics and facts pertaining to the agriculture of the State, from monthly reports rendered by hundreds of volunteer crop correspondents, information which assists the producer in his sales and interests all industries which deal with agricultural products;

Cooperates with U. S. Bureau of Agricultural Economics in joint crop and livestock reporting and publishes annual and monthly summaries of the data;

Compiles dates of county and local fairs and assembles data pertaining to their success and results during each year.

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## FACTS ABOUT THE DISEASE

Bovine Infectious Abortion is more important from an economic standpoint than any other disease of cattle now prevalent in this country.

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In Pennsylvania alone, it is estimated that the disease causes a loss of more than $5,000,000 annually.

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Ninety-two per cent of all cattle in a herd have been known to abort in a single year. Sixty-two per cent aborted or were sterile the next year.

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Where 10 per cent of a herd abort and 10 per cent are sterile annually, the equivalent of the whole herd in number of animals is lost every five years.

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The milk loss in abortion infested herds is enormous and soon eats up the entire value of the herd. Many animals are being maintained at a loss and herd owners have been forced out of the cattle business on account of the disease.

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The disease can be prevented; no cure is known.

# BOVINE INFECTIOUS ABORTION

## Its Importance, Sequelae and Suppression

By M. F. Barnes.

## ABORTION IN ANIMALS

Infectious Abortion occurs in all species of domestic animals, and with the exception of cattle and swine its cause is different. In cattle and swine it is caused by the same germ (Bacillus Bang). Infectious abortion in mares, although not widespread has been studied on different occasions by the Bureau of Animal Industry, Pennsylvania Department of Agriculture. The form known in ewes has not been reported in Pennsylvania. It is however, important to know that such forms of infectious abortion exist so that barriers may be constructed against them.

To define exactly what is meant by the term abortion is practically impossible. It has been defined as the expulsion of a fetus before it is fully enough developed to be viable. After the fetus is viable the condition has been termed premature birth. It seems however, that we should from the standpoint of infection, regard as an abortion, any premature delivery of a fetus whether dead or alive, viable or unviable. Animals may be infected and at the same time may give birth to their young at the time they would be normally due. The term abortion is a misnomer and does not indicate which animals are dangerous spreaders, and in its narrow sense, means only the arrest of development.

There are however, other abortions that cannot be attributed to infective bacteria but the infectious forms are by far the most common and all abortions until proved otherwise should be considered infectious.

## BOVINE INFECTIOUS ABORTION

Bovine Infectious Abortion is the adopted name for the disease caused by Bang bacillus. The name implies that it is first a disease of cattle and secondly that there is an abortion. We know that occasionally cattle abort as the result of causes other than Bang bacillus and also that all female cattle infected with Bang bacillus do not abort. A certain percentage of bulls become infected and it is impossible for them to abort.

Swine become infected with Bang bacillus although swine are not bovines. Bang abortion disease also implies an abortion. Abortion disease implies that abortions must occur but does not imply abortions due to a specific cause.

Animals which do actually abort are in the class of the worst spreaders but since many infected animals are bad spreaders when they calve apparently healthy calves at normal times, it might be a safer procedure from a herd management standpoint, to consider all births in infected herds, as abortions, whether the calf is born prematurely or at normal time and whether dead or alive, viable or unviable.

"Bang Bacillus Disease" might be a less confusing name and could well cover all classes of animals infected with Bang Bacillus regardless of its effect upon them.

### The More Important Question is the Effect of Infected Animals Upon Other Animals and Their Future Production.

Bovine Infectious Abortion, Bang Abortion Disease, Cattle Abortion Disease or Bang Bacillus Disease is a specific transmissible disease in cattle, swine and possibly certain other animals. Its most characteristic clinical manifestation is the act of aborting. It is quite frequently spoken of as a chronic disease which implies that it is a disease slow in reaching its effect and that animals remain infected over long periods of time. The latter is true but what the final effect of the disease is has not been definitely determined. We know that the final effect of the disease tuberculosis may be death of the afflicted animal and that one effect is the destruction of certain body tissues. We also know that one effect of Bang Abortion Disease is tissue destruction and fetal death (death of fetus) but this may be neither the first nor the final effect. Its effect on male animals is frequently the destruction of tissues as testicular and epididymal tissue. In female animals it is said to occasionally have a tissue destroying action on the udder.

### Much Money Has Been Wasted by Breeders in Trying Out the Curative Value of Useless and Possibly Harmful Concoctions.

If the act of aborting could be said to be a disease then it could be well termed an acute disease. Abortion, however, is only a symptom which may be repeatedly manifested in the same animal.

All classes of bovine animals are susceptible. Pregnant animals are apparently more susceptible than other females. Occasionally calves are born infected and remain infected to maturity. Most young calves, however, cease to react before six months of age. Non pregnant animals including virgin heifers also become infected.

It is generally believed that Bacillus abortus Bang is taken into the digestive tract through the mouth of the mother, and reaching the uterus by the circulation, attacks the membranes which surround the fetus and by working on these membranes destroys some of the connections of the young and the mother, and interfering with the nourishment of the fetus, causes irritation and contraction of the uterus and as a consequence the calf is born before it is fully developed, either dead or alive, depending upon whether the nourishment had been sufficiently interfered with or not.

Other possible channels of infection are through the eye, nose, teat canal and vagina.

The disease is usually first made manifest by the appearance of an abortion, although the act of aborting is not its only characteristic. If cows are carefully observed each day in herds where abortions are occurring it may be noticed that most of them show signs of abortion a short time before it occurs. The symptoms are often overlooked. The signs or symptoms may be a slight swelling or reddening of lips of the vulva, with slight discharge of mucus and enlargement of the udder, and in milking cows, probably a slight increase in the amount of milk. There may also be slight relaxation of the ligaments at the base of the tail and a general uneasiness. There may be seen in a less marked degree, the same line of symptoms as can be observed when a cow is due to calve at full term.

## It Is A Duty Of Breeders To Help Eradicate Abortion Disease.

The most favorable seat for the growth and development of Bacillus Bang is in the fetal membranes of the pregnant uterus and in the developed udder. It also has been found in the genital tract of infected bulls and in the stomach and intestines of newly born and aborted calves from infected dams. These should be considered as sources of infection.

Since the pregnant uterus is one of the most favorable seats for the growth and development of Bacillus abortus Bang, cows should be regarded as the most dangerous spreaders at the time of abortion and for a short time afterwards through discharges from the uterus and vagina. Next to the aborted cow infected cows at apparently normal calving time are dangerous spreaders. A cow does not necessarily need to abort to become a spreader. Not all animals affected with tuberculosis develop the typical symptoms of this disease, neither do all cows abort that are infected with Bang bacillus. In either case, however, the affected animals may be spreaders of the cause of the disease in question.

The Bacillus Bang has not been found in the uterus of cows for more than 58 days after an abortion or apparently normal calving and seldom has it been found later than 30 days subsequent to calving. After this time there should be little danger of healthy bulls becoming mechanical carriers from serving infected cows.

All animals infected with Bang Bacillus should be considered dangerous spreaders. All materials contaminated with Bang Bacillus should be considered sources of infection. The intestinal discharge from calves suckling infected mothers should be considered a source of infection. A large percentage of infected cows are life time carriers of Bang Bacillus in the udder and their milk should be considered a source of infection.

It has been shown that abortion can be produced by feeding materials containing Bang Bacillus and it is believed that most infections are contracted through materials contaminated and eaten as food or taken into the mouth in some other way. All food and water should therefor be guarded against becoming contaminated with Bang Bacillus.

## DIAGNOSIS

The history of the herd and the individual animal history are valuable aids in establishing a diagnosis of Bovine Infectious Abortion, but in order to definitely establish the diagnosis requires that the Bacillus Bang be found by microscopic or cultural study or that specific laboratory methods of study be used, for example, serological tests.

Most all herds to which cattle have been added from unknown sources or from sources where it is not known they are free from Bovine Infectious Abortion, are likely to be infected with Bang Abortion Disease. To establish a diagnosis of the presence of this disease in such a herd requires only that all animals in the herd be subjected to a blood test for Bovine Infectious Abortion.

A number of the smaller herds at least in Pennsylvania are free from infection with Bang Bacillus and in these herds the owners should aim to practice a system of herd management which will keep them free. This system of herd management must require the practice of the principles of disease prevention.

## MANIFESTATIONS

The presence of Bovine Infectious Abortion in a herd is not known usually until its most characteristic symptom, namely, an abortion has occurred. The losses encountered can be best related by those who have experienced a scourge of it.

Bang Abortion Disease manifests itself differently in the different herds. In most every herd in which this disease establishes a new center of infection, its introduction can be traced to herd additions or to animal associations in other ways which have the same effect. Occasionally this is due to neighbors cattle having broken in.

The period of incubation under natural infection is not definitely known but apparently is from four to five weeks upward. Usually after an added animal aborts a period of four to five weeks or more elapses before the next abortion occurs in this newly infected herd, after which time, abortions may occur rather frequently, the number depending more or less upon the number of animals in the herd and the percentage of these exposed. The conditions under which cattle are kept, stable arrangement, the practice of sanitary measures, etc., are factors which influence exposure.

In some herds the percentage of abortion may be rather low and may extend over a number of years. In other herds fifty to sixty or seventy-five per cent of the female animals may abort during the first year or two and the disease may then apparently disappear for a few years so far as actual abortions are concerned.

A small percentage of animals show an apparently natural immunity, and with repeated exposure calve normally year after year and remain negative to tests for abortion.

Whether a large number of abortions occur in one year or whether three or four years are required, if measures are not practiced to prevent its spread, 70 to 80 per cent of the herd will eventually have aborted, a number will have become temporarily sterile, a smaller number will have been disposed of on account of permanent sterility.

Approximately 40 per cent of those which abort once abort the second time, between 5 and 10 per cent abort the third time; a few the fourth and even fifth and sixth consecutive times. A few abort, give birth to several apparently normal calves, then abort again. Some abort, give birth to one or two normal calves, then abort two or three consecutive times.

A small herd of 13 cattle (females), 12 or 92 per cent aborted the first year. The next year four or 31 per cent were sold on account of sterility and 4 or 31 per cent of the original herd or 45 per cent of the remaining 9 aborted. 62 per cent of the original herd of 13 animals were sterile or aborted the second year.

One breeder stated that for 15 years his herd had averaged 15 per cent abortions. This is 225 per cent in 15 years. Add the sterility and the 225 per cent would be reached in less than 10 years and 100 per cent in less than 5 years.

The decreased milk production of herds extensively infected with Bang Abortion Disease constitutes a loss which requires only a few years to consume the value of the entire herd.

## THE SPREAD OF BANG BACILLUS

The spread of Bang Bacillus and consequently the spread of the disease which it causes has been brought about through the movement of infected animals and possibly to some extent through the movement of materials contaminated with Bang Bacillus. The widespread distribution of cattle in attempts to improve pure-breds has been to a considerable degree responsible for the wide distribution of the disease. At the present time it is one of the most widely distributed diseases of cattle, being prevalent in most every country where the cattle or dairy industry is developed. In this country it undoubtedly causes a heavier loss than any other prevalent cattle disease.

Cattle have been sold at public and private sale to take a place in herds other than those in which they had previously occupied a place and as a result of many of such sales new centers of infection have been established.

## THE BREEDER

### Breeders Owe It To Each Other To Sell Cattle Free From Bovine Infectious Abortion

Breeders of cattle in the past have not been fair with one another. Experienced breeders have understood for some time that when a cow was purchased the purchaser took the chance of also taking abortion disease to his home herd if it did not already exist there. The unfairness of dealing has been with the inexperienced or beginning breeder. It is not to the best future interest of breed societies to start new members in an unsound business which the business becomes when this new member has spend his ready capital in establishing a herd of abortion infected or sterile animals. On the other hand the cattle breeding business run on a healthy basis should be a profitable business.

No breeder at the present time would want to maintain a herd infected with Bang Abortion Disease if he could see a practical method of establishing a clean one. A number of breeders however believe that the proper application of blood tests and the removal of reactors, proper precautions in the addition of animals and the practice of necessary sanitary measures, have accomplished this end for them. Many more are hopeful. Considerable time will be required for all to understand and believe that this end can be accomplished. Many whose herds contain a rather high percentage of reactors believe that the elimination of these reactors is an unpractical procedure. If they were to analyze more closely it would in many instances be learned that a large proportion of the reactors are unprofitable and are maintained at a loss.

## IMPORTANCE

No disease of cattle in this country causes a heavier loss to the dairy and beef industries than does bovine abortion. Many owners of dairy herds have been forced out of business on account of Bang Abortion Disease and its sequelae. The loss in Pennsylvania is roughly estimated at considerably more than $5,000,000.00 annually. This is based on the estimated milk loss alone. Calf loss and loss to beef herds are not estimated.

Herds of cattle are efficient to a greater or lesser extent from several standpoints, from a breeding standpoint and from the standpoints of milk and beef production. Herds free from Bang Abortion Disease have been known to show an average breeding efficiency of 100 per cent over a number of years. Herds free from the disease usually range between 90 and 100 per cent efficient from a breeding standpoint. Herds extensively infected from a breeding standpoint usually fall below 60 per cent efficient and seldom go above 75 per cent either from a breeding or milk production standpoint. Herds showing a low efficiency must sustain a rather enormous annual loss and in a very few years the loss has amounted to more than the value of the herd.

The statements of a number of breeders who keep accurate records indicate that cows which abort will not produce on an average, more than half the amount of milk produced when calves are carried to maturity. Practically the same is true of cows which fail to conceive for a period of one year. To keep milk production at its highest point it is necessary for cows to freshen normally about once each twelve to fourteen months.

Assume that this is a purebred herd and located conveniently to a good milk market, and the average appraisal value of this herd of 100 cows is $200 per cow. The herd would then have a value of $20,000 Consider the average milk production for normal cows in the herd at 6,000 pounds worth five cents per pound. Each cow then should produce milk worth $300. annually. But thirty cows produce only 3,000 pounds, or a milk value of $150 each, which equals $4500 for the thirty, which amount is also equal to the loss in milk value the herd must sustain annually on account of abortion and sterility. Assume that 50 per cent milk production is sufficient to maintain (feed and care for) the 30 cows and we still have a $4500 loss to which should be added the value of 30 calves. It can be readily seen then that value equivalent to the entire value of the herd is lost every four to five years. If the appraisal value is $100 per cow or $10,000 for the herd the value of the herd is lost every two years.

### Practising Veterinarians Should Do Everything In Their Power To Check, Suppress, and Eradicate Bovine Infectious Abortion

The total number of cattle in Pennsylvania is estimated at 1,500,000. Estimated number of dairy cattle is 860,000 of which 80,000 are purebreds and 760,000 grades. Assume that of the total 860,000 dairy cattle one-third, which seems a low estimate, of the herds are infected. Then there would be approximately 280,000 cattle in infected herds. If in these herds there is 25 per cent inefficiency due to abortion and its sequelae there would be 70,000 cattle annually fail to produce.

Figured on the basis of a normal production of 5000 pounds of milk per cow sold at three cents per pound and a cost of $125 per cow for maintenance, each cow then should show a profit of $25 without considering a calf value, but since the total income per cow is $75 each cow shows an actual loss of $50 and a total loss of $75. The total loss then for 70,000 cows would be $5,250,000. The loss in beef breeds and calf loss in dairy breeds would be somewhat more difficult to estimate.

## TREATMENT

No successful method of treating infected animals has yet been discovered.

During our course of study of this disease in Pennsylvania over a period of at least 25 years, sufficient and possibly too much recognition has been given proposed remedies or cures, vaccines, preventives, etc. We have given place for trial of the carbolic acid method of treating pregnant cows, the methylene blue treatment, and have seen tried many of the other supposed remedies. There are still a few breeders who are willing to increase the maintenance expense of their herds in useless and possibly harmful concoctions which are purchased at comparatively high costs. Veterinarians should properly advise their clients as to the possible outcome after such remedies have been used.

Wonderful advancement undoubtedly will have been made when some agent has been discovered which will destroy abortion infection in the carrier cow. It is very likely that when this use of some agent is discovered it will not be by some person who has no conception of the nature of animals diseases as has been the case with many of the proposed remedies.

*Money which has already been expended by breeders in trying out useless remedies would, if it were available, establish and properly equip a research institute suitable for a concentrated study of this disease.*

No Suitable Immunizing Agent Has Yet Been Discovered.

The Use of Vaccine Has Not Eradicated Abortion From Any Herd.

Vaccinated Animals Become Carriers and Spreaders Of Bacillus Bang.

## CONTROL BY VACCINATION

A number of breeders have fully realized the failure of vaccines to protect them from losses.

It is not fair to presuppose that the injection of the cause of any disease into an animal will produce a lasting immunity when an attack of the disease itself does not establish immunity. Immunity has been successfully established artificially against many of the diseases which run an acute course but for those diseases, the course of which generally is not acute, there has been little accomplished.

That permanent immunity against Bang Abortion Disease in cattle is not established by an attack of the disease is proved by the fact that rather a high percentage of animals show the most characteristic symptom by aborting the second, third and even the fourth and fifth times.

108 cows in one herd (herd 2) showing a record of two or more conceptions per cow with an average of 4 and covering an average period of approximately 5½ years, 116 conceptions or 27% resulted in abortions and 316 in normal births.

The 116 abortions occurred in 73 or 67.5% of the 108 cows.

Of the 73 cows which aborted:

41 or 56% aborted only once
32 or 44% aborted more than once
25 or 34% aborted two or more consecutive times
5 or 7% aborted three or more consecutive times
3 aborted four or more consecutive times
1 aborted five consecutive times
1 aborted once then gave birth to five normal calves and aborted once more.
4 aborted once then gave birth to one normal calf and then aborted once more.
2 aborted once then gave birth to one normal calf and then aborted two consecutive times.
2 aborted once then gave birth to two normal calves then aborted once more.

60 cows in other herds showing a record of two or more conceptions per cow or a total of 178 conceptions, 51 of these conceptions resulted in abortion and 127 resulted in normal births. The 51 abortions occurred in 36 cows. 14 or approximately 40% of the 36 cows aborted more than once.

In an experimental study of the use of vaccine different experimentors have reported conflicting results. The results which have thus far been obtained do not indicate in face of other measures properly executed that our state or any other is justified in advocating the general use in living form of the cause of this destructive disease.

Dr. Ward Giltner reports that Huddleson of the Michigan station is doing work on what he feels is a culture of Bacillus abortus Bang possessing low or no pathogenic properties when administered to cattle in living form and at the same time possessing high antigenic properties. This work is experimental. However if it should develop as a result of Huddleson's work that the strain of Bacillus Bang with which he is working is not pathogenic for cattle, do we have sufficient knowledge at hand to determine whether this strain may not at some time become highly virulent.

Work done officially by the Bureau of Animal Industry, Pennsylvania Department of Agriculture, on the use of living culture vaccine in 10 different herds situated in 10 different sections of the state would contraindicate it use. In these 10 herds a total of 275 animals were vaccinated and 250 were left as controls.

The Pennsylvania results were somewhat conflicting. One herd went into bankruptcy and was sold at dispersal sale. In some of the herds abortion apparently ceased but this also happened among the animals which were not vaccinated. In other herds more breeding troubles occurred among vaccinated animals than among those which were left as controls.

After eliminating undesirable animals in both vaccinated and control groups, there were left which conceived in time to be considered in determining the final results a total of 187 vaccinated animals and 143 controls. 26.7% of the vaccinated animals aborted while only 24.5% of the controls aborted. This shows a little in favor of the animals which were not vaccinated.

The work was carried over a period of about 2½ years, from the middle part of 1920 until about the first of the year 1923, which gave time for the periods of gestation of cows which were vaccinated on the latest date, September 22nd, 1921.

The tables shown below include only the cows in several herds which were bred not before 60 days subsequent to vaccination and which conceived within a reasonable time after the 60 days had elapsed.

Table 1—Animals Vaccinated and Controls

| Vaccinated | | | | | Controls | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Number of Animals | Calved normally | | Aborted | | Number of Animals | Calved normally | | Aborted | |
| | Animals | Percent | Animals | Percent | | Animals | Percent | Animals | Percent |
| 187 | 137 | 73.3 | 50 | 26.7 | 143 | 108 | 75.5 | 35 | 24.5 |

The exact history of all animals in Table I is not known but for those the history of which is known Table II, shows the results of two classes, cows that had previously aborted and cows that had not previously aborted.

Table II

| | Vaccinated | | | | | Controls | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number of animals | Calved normally | | Aborted | | Number of animals | Calved normally | | Aborted | |
| | | Animals | Percent | Animals | Percent | | Animals | Percent | Animals | Percent |
| Previously aborted | 54 | 37 | 68.5 | 17 | 31.5 | 26 | 20 | 77 | 6 | 23 |
| Not previous abortion | 133 | 100 | 75.2 | 33 | 24.8 | 83 | 66 | 79.5 | 17 | 20.5 |

A number of the animals were blood tested previous to vaccinations. Table III indicates the animals that were positive and those that were negative to the blood test.

Table III

| | Vaccinated | | | | | Controls | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Calved normally | | Aborted | | | Calved normally | | Aborted | |
| | Number of animals | Animals | Percent | Animals | Percent | Number of animals | Animals | Percent | Animals | Percent |
| Neg. to blood test[1] | 82 | 63 | 77 | 19 | 23 | 45 | 37 | 82.2 | 8 | 17.8 |
| Pos. to blood test[2] | 81 | 58 | 71.6 | 23 | 28.4 | 35 | 26 | 74.5 | 9 | 25.5 |
| Neg. to test & no previous abortions | 82 | 63 | 77 | 19 | 22 | 44 | 36 | 82 | 8 | 18 |
| Pos. to test & previously aborted | 50 | 36 | 72 | 14 | 28 | 21 | 15 | 71.5 | 6 | 28.5 |
| Pos. to test & no previous abortion | 31 | 22 | 71 | 9 | 29 | 14 | 11 | 78.6 | 3 | 21.4 |

[1] Negative—free from disease
[2] Positive—disease found

A number of the vaccinated and control animals were virgin heifers. The virgin heifers which were employed in the vaccination experiments are shown in Table IV.

Table IV

| | Vaccinated | | | | | Controls | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Calved normally | | Aborted | | | Calved normally | | Aborted | |
| | Number of animals | Animals | Percent | Animals | Percent | Number of animals | Animals | Percent | Animals | Percent |
| Neg. to blood test[1] | 54 | 39 | 72.2 | 15 | 27.8 | 20 | 14 | 70 | 6 | 30 |
| Pos. to blood test[2] | 10 | 6 | 60 | 4 | 40 | 8 | 6 | 75 | 2 | 25 |
| Blood not tested | 7 | 4 | 57 | 3 | 43 | 14 | 12 | 85.7 | 2 | 14.3 |
| Total | 71 | 49 | 69 | 22 | 31 | 42 | 32 | 76.2 | 10 | 23.8 |

[1] Negative—free from disease
[2] Positive—disease found

## BACTERIN

30 cows ranging from two to seven months pregnant were given bacterin or dead cultures of bacillus abortus (Bang).

16 of the 30 or 53.3 per cent aborted.

10 of the 30 ranged from 2 to 4½ months pregnant.

4 of the 10 or 40 per cent aborted

20 of the 30 ranged from 4½ to 7 months pregnant.

12 of the 20 or 60 per cent aborted

23 of the 30 were blood tested five months previous to the injection of bacterin.

9 of the 23 were negative.

3 of the 9 or 33⅓ per cent aborted

14 of the 23 were positive.

9 of the 14 or 64.3 per cent aborted.

We know of no herd from which the use of vaccine has eradicated bovine infectious abortion. Animals vaccinated with living culture of Bang bacillus become carriers and recent work by certain experimenters has shown that a rather high percentage of them become spreaders. In disease control work every carrier should properly be considered a spreader.

## THE PROPER METHOD FOR PREVENTION AND REPRESSION OF BOVINE INFECTIOUS ABORTION

There is no better indicator of a necessity of successful methods of prevention, control and repression of bovine infectious abortion than the infected herd itself from an efficiency standpoint.

In all methods which have been tried by the Bureau of Animal Industry, Pennsylvania Department of Agriculture, except the method whereby reactors have been removed and sanitary precautions practiced the herds under supervision have remained at a low point of efficiency.

Soon after the discovery of the cause of bovine infectious abortion by Prof. Bang in 1896, principles were outlined for the control of this disease. These principles were based on sanitation and today are principles basic to the best known methods for the prevention and control of bovine infectious abortion. Ever since the discovery of the cause of this disease the policy of the Pennsylvania Bureau of Animal Industry has been to recommend its control through the application of such principles but as stated previously the Bureau has caused or carried out investigations of other methods. More knowledge is available concerning the nature of this disease at the present time than was previously. In addition to the principles previously recommended it is recommended at the present time that maternity stalls be supplied and properly used and that the blood test be used as a guide in the methods of handling individual members of the herd or as a guide in handling the entire herd.

During the years 1911 to 1916 a considerable amount of blood testing was done in Pennsylvania and a certain amount has been done each year since that time. The earlier tests were no doubt as accurately applied but at that time no attempts were made to separate herds in accordance with the results obtained by the use of the test, for the reason that abortions occurred among animals which were negative and those which were positive did not abort in every case. The same condition exists at the present time but after all reactors have been removed from a farm over a considerable period of time the number of abortions among animals which remain negative on several consecutive tests should be reduced to a minimum. Herds are known in which no abortions have occurred for at least three years. This is unusual when it is considered that a few abortions occur from causes other than Bang bacillus.

Some are of the opinion that the blood test for abortion is not accurate, and that the same results are not always obtained. This is also true of any other test but where animals have been followed up and repeatedly blood tested for abortion with a uniformly standard agglutinating fluid the results have been quite uniform except a slight variation in the degree of reaction. At any rate the test in conjunction with the removal of reactors and sanitary measures has been a successful method of eliminating bovine infectious abortion from herds of cattle. Occasionally animals which were once positive become negative on a later test. We believe that the agglutination test for bovine infectious abortion properly carried out at proper intervals compares very favorbly with the tuberculin test. At the present time we consider reacting animals as dangerous animals to keep in the herd where they come in contact with healthy animals.

> The Proper System of Herd Management Would Often Prevent The First Abortion as Well as Those Which Follow

Positive animals may not be spreaders of the disease at the time of the reaction but there is no way to foretell at what time they may become spreaders. Every carrier should be considered a spreader.

Our Bureau has unsuccessfully attempted to eradicate Bovine Infectious Abortion by separating reactors and non-reactors into two rows in a stable and requiring that these two groups go into separate pastures. We have been successful in eliminating abortion from herds where there has been complete separation of reactors and non reactors on separate parts of the farm or where reactors have been immediately disposed of, provided proper follow-up tests were carried out and proper precautions were used in addition of animals to the clean herd.

In abortion prevention and control work, patience, perseverance, close observation of individual members of the herd, and proper action at the right time, are duties of every herdsman. A proper system of herd management includes a system of disease prevention and control. The usual system of herd management tends to keep active, instead of eliminate, abortion infection. The proper system of herd management would often prevent the first abortion as well as those which follow.

If breeders desire that bovine infectious abortion be eradicated from their herds and will sufficiently persevere that end can be accomplished. Repeated application of blood test will determine which animals are infected and bovine infectious abortion will eventually be eradicated from the herds under supervision provided reactors are eliminated and other necessary precautions are carried out.

The abortion committee of the United States Livestock Sanitary Association in its 1924 report, reported vaccines still in the experimental stage and laid most stress on sanitary measures in conjunction with blood tests as a means of control.

The Pennsylvania Plan which was first prepared in December, 1921 and has recently been revised is a plan based on sanitary principles and includes repeated blood testing of the herd and elimination of reactors. It includes a form of certificate which has been issued. Its principles were in operation in some herds for considerable time before it was prepared in 1921. No herd is eligible for the adoption of this plan the owners of which are not also practicing measures for the prevention, control and eradication of tuberculosis.

**If Breeders Desire That Bovine Infectious Abortion be Eradicated From Their Herds of Cattle and Will Sufficiently Persevere, That End Can Be Accomplished.**

# THE PENNSYLVANIA PLAN FOR THE PREVENTION, REPRESSION AND ERADICATION OF BOVINE INFECTIOUS ABORTION

Made December 1, 1921—Revised December 1, 1924.

The Bureau of Animal Industry, Pennsylvania Department of Agriculture, (formerly the Pennsylvania Live Stock Sanitary Board) ever since its organization has studied the disease of cattle now known as "Bovine Infectious Abortion", always with the hope that suitable methods for its prevention and repression would be devised.

Soon after 1896 when Professor Bang discovered the cause of infectious abortion, Pearson outlined some principles for its control which were dependent upon isolation, sanitation and disinfection. With the foundation already laid, an increasing study has added much to the knowledge of the nature of this disease, thus making possible the employment of more effective methods of prevention and control.

In November of 1919 the officials of the Bureau of Animal Industry, Pennsylvania Department of Agriculture, conceived the idea of establishing a health standard with respect to Bovine Infectious Abortion. The adoption of such a standard would benefit the livestock industry in several ways:

1. Improve the quality of the herd. Increase the quantity and decrease the cost of production.
2. Would stimulate stockmen to establish abortion-free herds.
3. Provide a safe place for prospective purchasers to obtain new animals.

A certificate will be issued to herds under Bureau supervision which have qualified.

The following is a copy of the first certificate which was issued December 16, 1921:

> Certificate of Inspection and Test for Bovine Infectious Abortion.
>
> Certificate No. ........ Issued ..............192 .
>
> This is to certify that the entire herd of .............. of ............P. O. ..........County, Pennsylvania, consisting of ..........cattle has undergone inspection; has passed the required number of blood tests; the owner has complied with the requirements prescribed by the Pennsylvania Bureau of Animal Industry for the prevention, repression and eradication of Bovine Infectious Abortion; and the history indicates the absence of infection with Bovine Infectious Abortion.
>
> The above-mentioned animals have been found free from all evidence of Bovine Infectious Abortion and are approved by the Bureau.

This certificate is good for one year from the date issued unless revoked.

..............................
State Veterinarian.

## Outline of Plan

(1) An abortion free approved herd under the Pennsylvania Plan is one in which no evidence of bovine infectious abortion has been shown and in which no reactors to the abortion blood test have been found over a period of at least one year.

(2) The owner must place his herd under supervision of the Bureau of Animal Industry, Pennsylvania Department of Agriculture, for the prevention, repression and eradication of Bovine Infectious Abortion.

(3) The history is obtained and blood is collected from the entire herd by the Pennsylvania Bureau of Animal Industry or under its supervision and tested by said Bureau.

(4) A list of cattle tested shall be supplied the Bureau at each time a test is applied so that each blood sample can be identified by the name of the cow, tattoo or eartag number.

(5) A herd in which there are reactors to the first test, all reacting animals shall be either placed on a separate farm and will be known as the "Infected Herd", or shall be disposed of in a manner satisfactory to the Bureau of Animal Industry. The animals which pass the test, if separated from the reactors, shall be known as the 'Clean Herd".

(6) A herd in which reactors are found as described in Section 5, a retest must be applied to the clean herd in at least 60 days subsequent to the date of the first test, and additional reactors must immediately be placed in the infected herd or disposed of as provided in Section 5.

(7) The clean herd shall be tested at such intervals as deemed advisable by the Pennsylvania Bureau but in no case shall there be a period of more than one year between tests. If additional reactors are found they shall be handled as provided in Section 5. Animals from the infected herd which do not show a reaction may be placed in isolation and retested in 60 days, and if they pass the retest may be placed in the clean herd, provided this does not conflict with Section 12. Individual animals shall be subjected to such tests and at such intervals as the Bureau of Animal Industry deems advisable for the effectual working of the plan.

(8) Herd bulls must not be used for service to cattle in other herds.

(9) All milk and other dairy products fed shall be either produced by an approved herd or shall be properly pasteurized.

(10) Cattle from approved herds may be added without test. If shipped, the car must be cleaned and disinfected, and public stock yards must be avoided.

(11) All cattle other than those from approved herds to be added must have passed a blood test approved by the Bureau of Animal Industry, must be isolated for a period of at least 60 days and must have passed the second test applied in accordance with Section 3.

(12) In no case shall pregnant animals be added to a clean herd unless coming from an approved abortion-free herd. Pregnant animals other than those from abortion-free approved herds to be added must be isolated until after having calved and must have passed a blood test not within two weeks after having calved.

(13) Cattle removed from the farm for exhibition or any other purpose shall be provided with separate quarters and shall not be exposed to cattle other than those from approved abortion-free herds. If shipped, Section 10 must be complied with.

(14) Any animal which aborts in any herd under supervision must be immediately isolated and reported to the Bureau of Animal Industry. The place where the abortion occurred must be immediately cleaned and disinfected; the fetus and membranes must be properly disposed of.

(15) The premises must be in a sanitary condition. After the removal of affected animals the stable must be cleaned and disinfected under official supervision.

(16) No herd will be placed under supervision the owner of which is not practicing measures against tuberculosis.

(17) The work of the Bureau of Animal Industry will be conducted cooperatively with the owner and his veterinarian.

(18) A certificate will be issued to herds in which no reactors have been found over a period of one year and which the history indicates are free from this disease, provided the above requirements have been complied with and the following agreement has been properly signed and executed.

### Agreement of Owner with the Bureau of Animal Industry, Pennsylvania Department of Agriculture.

I hereby agree to the terms of the above plan for the prevention, repression and eradication of Bovine Infectious Abortion. I also agree to observe and fulfill the foregoing requirements. And I agree further: That failure on my part to comply with the foregoing shall be sufficient cause for cancellation of this agreement.

My herd consists of the following cattle.

| | Purebred | Grades | Total |
|---|---|---|---|
| Females over 1 year of age | | | |
| Females under 1 year of age | | | |
| Males over 1 year of age | | | |
| Males under 1 year of age | | | |
| Total | | | |
| Predominating Breed | | | |

Date ____________________192 . Owner ____________________

Witness ____________________ Address ____________________

## The Value of Animals of High Merit Warrants Keeping Them Separate in Order That the Breeder May be Benefited by Their Blood Lines Obtained In Offspring

## ESSENTIALS

Whether ones aim is to control and suppress Bovine Infectious Abortion through the adoption of the Pennsylvania Plan or some other plan based on the principles contained in the Pennsylvania Plan, there are certain essentials necessary in obtaining the best results. In some herds the percentage of reactors is so high that to adopt the Pennsylvania Plan would require that most all animals be taken out of the herd. In this case it is doubtful if the adoption of the plan in its entirety would be advisable. On the contrary it might be advisable to consider the entire herd infected and depend upon its offspring for building up a herd free from bovine infectious abortion and eventually incorporating into this free herd the animals from the original herd which show repeated negative readings to the blood test. The further aim then should be to finally dispose of the original reacting herd.

It does not matter what method is adopted for the control of this disease, the future aim should be to eventually eradicate infectious abortion. With this aim in view, it will be more quickly accomplished by observing the following principles:

1. Improvements in blood lines should be made as much as possible by careful selection within the herd rather than from outside sources, thus excluding outside infection.
2. There should be provided a separate stable known as the maternity barn for cows at calving time. This stable should be so constructed that it can be easily and thoroughly disinfected, or better, fumigated with formaldehyde. On farms containing a large number of cows it should have a sufficient number of completely separated stalls to accommodate the number of cows that would be calving at one time.
3. Every cow should be removed from the herd and placed in the maternity stable at calving time. Cows showing symptoms of abortion should be placed either in the maternity stable or in a hospital stable maintained especially for the purpose of animals showing evidence of disease. All cows placed in the maternity stable should be kept there until all discharges following calving have ceased.
4. All afterbirths and aborted or dead calves should be carried in a non-leakable container to a suitable place and should be well buried or burned immediately.
5. The maternity stall should be well cleaned and effectively disinfected or preferably fumigated before another cow goes into it. The manure and litter should not be placed in the exercise or feed yard.
6. The herdsman should observe all pregnant animals daily and should remove suspicious animals from the herd before any considerable damage has been done.
7. In case an abortion has occurred in a stable the cow should be immediately isolated, the fetus and membranes should be carried in a proper container to a suitable place and burned or buried, the stable should be well cleaned and disinfected. An abortion occurring in the pasture field should be handled in the same way. The earth at the point where the abortion occurred should be covered with three or four inches of lime or a strong disinfectant or both.
8. Every case of abortion should be considered infectious until otherwise determined.
9. Feed should be obtained from such sources and should be so stored that it will be insured against contamination with disease producing organisms.
10. Manure piles should not be stored in the exercise or feed yard. There should be no barnyard manure pile. No cow should have access to manure piles at any time.
11. Bull clubs should be considered as consisting of units and handled as individual herds. Members of bull clubs should exercise extreme caution as pertains to abortion and other transmissible diseases.

12. Herd bulls should not be used for service to neighbors cows.

13. If purchases are to be made the history of the herd from which one wishes to purchase and the individual animal history should be determined and if either is doubtful the purchase should not be made until the animals health is definitely determined, and even then it is safer to purchase from healthy herds.

14. Pregnant animals should not be purchased unless isolated until they have given birth to a calf, have passed a satisfactory blood test not within two weeks after having calved, and the discharges following calving have ceased.

15. No person should be permitted to inject a vaccine or serum to prevent abortion unless it has a stamp of approval by the state official charged with the prevention, control and repression of transmissible animal diseases in the state. Vaccines and Bacterins cause reactions.

16. No animals susceptible to this disease should have access to neighbors' animals. All animals under supervision should be protected from neighbor's animals in such a way that there is no communication whatever.

17. The blood test should be applied at frequent intervals, and all reactors, both male and female, immediately removed, until all remaining animals have passed several consecutive tests.

18. Every reactor should be considered a carrier and every carrier should be consideed a spreader.

19. Every cow in the herd should be considered a spreader at calving time until no reactors have been found over a period of at least one year.

20. Reacting animals possessing little value from a breeding standpoint or when unprofitable should be disposed of.

21. The value of animals of high merit warrants keeping them separate in order that the breeder may be benefited by their bloodlines obtained in offspring.

22. It is much easier to keep herds free from Bovine Infectious Abortion than to establish free herds from those which have become infected.

23. Prevention of disease is much more economical and more effective than cures.

24. Veterinarians, breeders and herdsmen should be slow in becoming discouraged when attempting, by proper measures, to eliminate abortion infection from the herd.

25. Remember that it took some of our most modern live stock owners almost 30 years to understand that it is more profitable to maintain herds free from tuberculosis by the adoption of proper preventive and control measures than to maintain diseased herds. So will it take time for them to understand that it is more economical to keep herds free from Bovine Infectious Abortion.

## OBTAINING THE BLOOD

Blood should be collected from all animals in the herd. After the reactors have been removed to a separate part of the farm, provided this method is adopted in preference to disposal, it is not then necessary to test the reactors again for six months to one year unless to check errors.

Unless the cows are identified by tattoo or chain lock numbers, especially in large herds, it is very easy for errors to occur. Occasionally the wrong number can be placed on a blood sample or on several samples. The name of one cow may be given when it was intended to give another. The herdsman may at the time mistake one cow for another then when the report on results of test is received he may have this mix corrected in his mind. One of the cows may have been positive and the other negative to the test and as a result of the original confusion in the names of the two cows, the wrong cow is removed from the herd. The next time the test is applied the results are apparently reversed. We will then very likely find a negative sow in the reacting herd and apparently an additional reactor in the clean herd.

Tattoo or chain lock numbers would often prevent such errors as mentioned above. It is much more important that animals be properly identified in testing for abortion than in testing for tuberculosis. In the latter case the reaction identifies the animal while in the former the test is applied in a laboratory, possibly many miles distant.

It is also possible for errors to occur in the laboratory. Where numbers are not easily distinguished on the tubes or do not run in consecutive order, they may occasionally be improperly identified. Blood is occasionally sent to the laboratory with the same number on two or three tubes and no other identification. Possibilities of errors should be checked by a retest on animals suspected of being in error.

Errors are less likely to occur if the tubes are numbered consecutively, one to the total number of samples in the shipment.

A list of animals properly identified should be supplied the laboratory with each lot of blood samples to be tested. On the list should be placed opposite the serial numbers occurring on the tubes, all information of value in identifying the animal, example:

| Serial number | Tattoo Lock or Herd number | Name and Description of cow |
|---|---|---|
| 1 | Tat. 14 | |
| 2 | Ch. 72 | |
| 3 | Tat. 109 | |
| 4 | Tat. 43 | |

The date of birth, or age, the sex and the registry number if possible should also be given. If there is a doubtful history it should be stated for each animal. The record should be made in duplicate and one copy sent with the blood and the other should be kept on the farm for identifying the animals after the results have been reported in accordance with numbers appearing on the blood tubes. The Pennsylvania Bureau furnishes a form for recording such data.

## BLOOD TESTS

The agglutination and complement fixation are the two tests usually applied to the blood of cattle to determine if they are infected with bovine infectious abortion. The complement-fixation test is rather complex and requires careful technic in its application. The agglutination test is more universally used than the complement-fixation, its technic is not so complex and the results obtained from its application are as accurate as those obtained from the application of the complement-fixation test. The agglutination test applied repeatedly to animals the history of which was known has not failed to detect animals which had reacted to the complement-fixation. On the contrary it has detected animals showing a history of infection wherein the complement-fixation had failed,

At present the agglutination test is the standard test adopted by the Pennsylvania Bureau in suppression of Bovine Infectious Abortion and its repeated application has accomplished the end that Bovine Infectious Abortion has been completely eradicated from a number of herds provided reactors to this test were immediately removed from the herd and the other necessary sanitary precautions as outlined in the Pennsylvania Plan were carried out.

In carrying out the agglutination test blood from each animal is tested in several dilutions. When used in dilutions of 1:25, 1:50, 1:100 and 1:200 in a standard agglutinating fluid, being repeated at frequent intervals, it is possible to pick out infected animals.

The agglutinating fluid is a uniform suspension of Bang Bacilli in a one-half of one per cent carbolic saline solution.

Our method of reading the test has been to classify all animals positive, the serum of which causes complete agglutination in dilutions of 1:50 or higher. Those which show incomplete agglutination in a dilution of 1.20 or 25 are termed slightly suspicious and are retested about two weeks later. Those showing complete agglutination in a dilution of 1:25 and incomplete in 1:50 either or both, are termed highly suspicious and are either retested or handled as reactors.

There are those who do not classify animals showing a reaction in dilutions under 1:200 as spreaders. We are not far enough advanced in our knowledge at the present time to state whether it is safe to leave animals in a clean herd if they show a reaction in dilution under 1:200 and do not show a reaction up to or above this dilution. A number of animals have been studied by our Bureau which showed no reaction until after an abortion had occurred and the day following the abortion reacted only as high as a dilution of 1:50. The fact that clean herds show no reactions in dilutions as low as 1:25 is sufficient evidence that the presence of Bang Bacillus is the cause of this specific reaction in higher dilutions. It seems therefore that the only safe procedure at the present time is to consider complete agglutination in any dilution above 1:25 as positive evidence of the presence of Bovine Infectious Abortion.

Sterility and Abortion Interferes with the Propagation of Certain Blood Lines, Limits the Number of Valuable Offspring, Hinders the Selection of the Best Individuals as Breeding Stock and Reduces the Amount of Milk Produced by the Herd

## SEQUELAE OF ABORTION

*RETAINED FETAL MEMBRANES* are usually considered sequelae of Bovine Infectious Abortion. However, the fetal membranes are frequently retained in herds free from the disease. This condition undoubtedly occurs more frequently in infected than in clean herds.

Retention of the membranes should be looked upon, not as a symptom of infectious abortion but rather as an indication of its possible presence in the herd. Abortion as a cause may be eliminated through the application of the blood test to the entire herd.

*STERILITY* is of very grave importance to the cattle breeding industry. A higher percentage of sterility is found in herds infected with Bang Bacillus than those free from infection. Bacillus Bang is usually considered an indirect cause of sterility and is possibly indirectly responsible for more than fifty per cent of the cases of sterility in cattle and directly responsible for a small percentage especially in the bull. There is a certain percentage of sterility in any large herd but if the percentages of abortion and sterility are represented graphically the sterility graph usually follows the general order of the abortion graph.

A dairy cow to function properly, besides producing a good quantity of milk, should give birth to a normal calf each twelve to fourteen months. This is a normal physiological function necessary for milk production to maximum capacity. Cows which do not freshen within this length of time, the amount of milk produced usually becomes reduced to a point that the cow is maintained at a loss.

*DECREASED PRODUCTION* is another sequel of abortion, the extent of which, will eventually determine whether the herd can be maintained at a profit or whether bankruptcy must follow. By decreased production is meant a decrease in number of offspring and amount of milk. These subjects have been quite thoroughly discussed under the heading, *"IMPORTANCE."*

*GRANULAR VAGINITIS* occurs in herds free from bovine infectious abortion and should not be considered a sequel of abortion. It frequently appears as the cause of temporary sterilities.

## THE BULL

The part played by the bull in the spread of bovine infectious abortion from one animal to another is not clearly understood. His relation to the spread of this disease probably depends upon whether he is infected or not. Bull's semen containing B. abortus Bang should be considered just as dangerous as any other material containing that organism. Reacting bulls should not be pastured with non-reacting cows. If infected bulls are a factor in the spread of Bovine Infectious Abortion and it is through the presence of the organism in their semen that they become a factor, then to douche their sheath either before or after service would be of no avail in prevention of the spread of the disease. Reacting bulls should be handled in the same manner as reacting cows and should be eliminated from clean herds.

Since Bacillus Bang can seldom be found in the genital tract of cows for more than from 30 to 60 days after calving the practice of serving cows after that time should be safe so far as transmission of infectious abortion by the bull is concerned. Non-reacting bulls which are permitted to serve reacting cows only after the genital tract of the latter are clean and free from discharge should not contract the disease nor carry it mechanically when used on healthy cows. If the genital tract of the cow is in the proper condition when she is served there should be no necessity of douching the sheath of the bull after service.

# SUNLIGHT

Sunlight is known to be an effective disinfectant, therefore, stables so constructed as to receive the greatest amount of sunlight possible, are well constructed. However, we should not depend too much on sunlight as a means of disinfection. There are places in all stables that sun rays do not reach and it is necessary to use other methods of disinfection where disease producing bacteria exist. This cannot be practiced too frequently nor too thoroughly. We should always aim to use a good reliable and effective disinfectant